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Pieri and Dubois that it belongs to the enzymes lacking in support as yet.

The observations which have just been briefly summarized add to the accumulating evidence that fertilization may be essentially a process of stimulation of the egg. This, of course, is true only if one leaves out of account the contribution of hereditary tendencies made by the spermatozoön, which add to the variability of the offspring. The egg, however, apparently contains everything necessary for the production of a new and complete organism like the mother, and needs only appropriate stimulation to start it on its course of development (see Koulagine, 1898, *Zool. Anz.*, 21, p. 653; also Delage, 1900, *Archives de Zool., Exp.* (3), 7, p. 525). In this direction point also the observations of Tichomirov, who showed that the unfertilized eggs of *Bombyx mori* can be made to develop, at least to an advanced embryonic stage, either by dipping them in sulphuric acid or by brushing them; likewise the observations of Dewitz, who obtained cleavage of unfertilized frog's eggs by treating them with corrosive sublimate; likewise the observations of Hertwig, who observed a similar result following the treatment of sea-urchin eggs with strychnine; further, those of Koulagine (already cited), who has induced cleavage of certain fish and amphibian eggs by treating them with the antitoxin of diphtheria; and those of Klebs, who found that parthenospores are formed in conjugating filaments of Spirogyra, in the presence of salt or sugar solutions of appropriate density. Still more emphatically is this indicated by the recent work, already mentioned, of Morgan, and especially of Loeb.

W. E. C.

PETROGRAPHY.

Graphic Representation of Rock Composition and Schemes of Rock Classification. — The recent great increase in our knowledge of rocks and the complexity of their chemical relationships is responsible for the attempts now being made to indicate by graphic methods these relations and incidentally to classify rock magmas on some chemical basis. The differential hypothesis was intended to explain the cause of the chemical relations existing between rock masses. It cannot serve, or at any rate it has not served, as a basis for rock classification. Rocks as objects of study are but portions of differentiated masses. A rock classification must deal with these portions, and it must necessarily deal with well-characterized portions or types. The difficulty in all classification schemes has been to select such types as will express the essential differences between nearly related rock masses and at the same time to show the relationships existing between them. The graphic method of representing rock analyses by diagrams serves to emphasize the characteristic chemical features of the different specimens analyzed, and to enable the student to recognize readily their differences and similarities. From these diagrams a composite diagram may be constructed, and this represents a chemical type. The chemical relationship of various types is easily read from their diagrams; and classification of the diagrams is a classification of rocks according to chemical composition. The first complete diagrammatic representation of rock composition was suggested by Brögger.[1] His diagrams are polygons drawn from the ends of radius vectors whose lengths correspond to the proportions of the constituents in the rock represented in the diagram. The shapes of the polygons show at a glance the relative importance of the principal components. They are extremely characteristic of the different rock types, and thus may be used to exhibit chemical relationships.

Hobbs[2] makes a few unessential modifications in the Brögger diagrams and combines them to form composite diagrams or diagrams of rock types. This he does, however, not by actually combining the individual polygons, but by averaging the analyses of the rocks which are assumed to belong with the type in question. So far as rock classification is concerned this method is not of great value, since it does not exhibit the differences in composition between the constituent members of the composite and the type produced by them. It affords a very convenient method of exhibiting the peculiar chemical characters of rock families and a concise method of showing their chemical relationships with one another, but the personal element enters so largely into the selection of the rocks that comprise the groups represented in the diagrams that these are not of great use in other respects. If the analyses represented in the diagrams could be averaged in such a way as would take into account the abundance of the various rocks, the composites would possess a high scientific interest. The idea proposed by the author is, however, an excellent one, especially for comparative purposes. It is bound to be received with favor.

Harker[3] suggests a method of using diagrams of rock series with a view to determining the mode of origin of certain rock masses. He lays off on a system of rectangular coördinates the proportions of the chemical constituents present in the known members of a series of rocks derived by the differentiation of the same magma, and draws lines through the corresponding points in the figure. Then by interpolation the composition of intermediate members of the series may be determined by inspection. When the lines passing through the points representing the proportions of the constituents present in the various rocks are straight lines, the series concerned is a "linear series," that is, the rates of change in the constituents are constant and their proportion is determined by the percentage of SiO_2 present. This is a "rock series" in Brögger's sense. Such a rock series, however, Harker thinks nonexistent. The normal diagram of a "rock series" consists of curved lines, some of which are concave and others convex. Sometimes when a rock's analysis is plotted the discovery is made that it does not fit into the diagram of the series. Such abnormal rocks may have been formed by the admixture of two magmas, or by the solution of foreign rock fragments in a normal magma. In either case the resulting mixture possesses a peculiar composition, the plotting of which does not fit into the diagram. For instance, the lavas of the Lassens Peak district, comprising basalts, andesites, dacites, and rhyolites, form a rock series the composition of which may be represented by a well-defined diagram. The quartz-basalts, however, refuse to adapt themselves to the scheme. Their abnormal composition is clearly brought out by the plotting. In their content of lime and potash they do not differ notably from normal rocks of the same silica percentage, but they show a marked deficiency in alumina and ferric oxide and to a less degree in soda. Magnesia and ferrous oxide are in excess.

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[1] *Das Gangafolgs des Laurdalits*, p. 255. Kristiania, 1898.

[2] *Journ. of Geol.*, vol. viii (1900), p. 1. [3] *Journ. of Geol.*, vol. viii (1900), p. 389.

The plotting of analyses in the manner indicated by the author, and the interpretation of the diagrams thus made in the way outlined above, form a ready means of detecting rocks of abnormal composition in a set of normal rocks from the same petrographic province. The diagrams thus may be made a means of aiding rock classification, since they enable one to exclude from discussion those rock species which can have no part in any series of related rocks, and which if discussed together with normal rocks would give rise to difficulties hard to overcome in any scheme of classification. The author declares that a natural classification "must be based, confessedly or implicitly, upon fundamental genetic considerations, and primarily upon the mode of operation of the processes of differentiation in rock magmas. Rocks resulting from admixture must therefore be excluded from the main scheme and be relegated to an appendix. Any discussion which tends to the recognition of this principle and to the establishment of some criterion of distinction will forward the object by disembarrassing the problem of a disturbing element."

The most recent and most complete discussion of the chemical elements of rocks is by Osann,[1] who proposes a formula for each rock which shall represent approximately its chemical composition and at the same time be capable of easy plotting. He also proposes a method of plotting by which the composition of a rock is indicated by the position of a dot in a triangular diagram. The dot in its relation to the bounding lines of the triangle exhibits at once the relative proportion of the important constituents in the rock mass. A single dot thus represents an entire rock. By plotting a large number of rocks on the same diagram their chemical relationships are easily and conveniently studied. The plotting at once exhibits a grouping of closely related rocks and differentiates those whose mineral composition may be similar but whose chemical composition is different. The personal element has no place in the system of plotting. The types are determined solely by the grouping of the dots which express by their position the composition of individual specimens. In the constructure of his rock formulas Osann transforms the percentage analyses into molecular proportions and recalculates to the sum of 100. The mean of two analyses of the norite [2] of Montrose Point on the Hudson River thus treated becomes

SiO_2	Al_2O_3	FeO	MnO	MgO	CaO	Na_2O	K_2O
59.50	10.35	7.38	.36	8.14	8.65	4.23	1.39

The percentage of SiO_2 (including ZrO_2 and TiO_2) in the recalculated analyses is represented by S with the corresponding exponent. By A is represented the alkalies in the molecular group $(NaK)_2 Al_2O_4$. In the above instance $A = 5.62$. The lime is considered as in the group $CaAl_2O_4$ and is represented by C. But CaO may be present in another molecular group, whereas the Al_2O_3 occurs only in groups A and C. Hence $C = 10.35$ (molecular percentage of Al_2O_3 in analyses) minus 5.62 (the proportion of Al_2O_3 in group A) $= 4.73$. The remaining oxides are regarded as being present in the group (Fe, Mn, Mg, Sr, Ba, Ca)O, and this is represented by F, which measures the dark components of the rock mass. In the norite $F = 19.78$, *viz.*, $FeO = 7.38 + MnO = .36 + MgO = 8.15$, and the remainder of CaO left after subtracting 4.73 CaO (the amount necessary to combine with the 4.73% of Al_2O_4 in group *C*) from 8.65 CaO, the amount shown in the analysis. The relation of the alkalies to one another is indicated by the letter *n*, which is given a value corresponding to the proportion the Na_2O bears in the analysis to the total alkalies calculated to the unit 10. In the above analysis the Na_2O is to K_2O as 4.23 is to 1.39, or as 7.5 is to 2.5. *n* thus is 7.5. The formula of the rock is

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[1] *Tscher. Min. u. Petrog. Mitth.*, Bd. xix, p. 351.

[2] *Amer. Jour. Sci.*, vol. xxxiii (1887), p. 193.

$$S = 59.50, \quad A = 5.62, \quad C = 4.74, \quad F = 19.78, \quad n = 7.5.$$

In the plotting the absolute values of *A*, *C*, and *F* are not used, but instead their proportions are calculated to a total of 20 units, and these ratios are made use of. The values 5.62, 4.74, and 19.78 are as 4 : 3 : 13 in the scale of 20, and the simplified formula is $s_{59.5}$, a_4, c_3, f_{13}, $n_{7.5}$. This formula not only expresses the approximate chemical composition of the rock for which it is calculated, but it expresses also roughly the proportions of alkaline feldspars, lime feldspars, and dark components present in it, and from the formula may be calculated the analysis. The ratios $a : c : f$ are represented in a triangular projection by a dot, the position of which discloses at a glance the chemical character of the rock it represents. Rocks of similar composition are represented by groups of dots in certain portions of the triangle, and these groups are observed to fall naturally into subgroups. The discussion of these features is reserved by the author until after he has plotted the effusive rocks. The present paper deals exclusively with rocks possessing the granitic texture. Of these the author has investigated over 200. He has recalculated the proportions of each of the analyses and has plotted them in a series of projections. A final projection contains all the types and thus serves as a summary of the work. Among the rock analyses studied, 40 are of granites, 36 of syenites, 37 of diorites, 28 of eleolite-syenite, 27 of gabbros, 23 of essexites and theralites, 4 of iolites and other rare basic rocks, and 11 of peridotites.

Moses and Parsons,[1] Elements of Mineralogy, Crystallography, and Blowpipe Analysis, etc. — The new edition of Moses and Parsons's *Elements of Mineralogy* covers concisely the greater part of the field of mineralogy. As its title indicates, it not only treats

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[1] Moses, A. J., and Parsons, C. L. *Elements of Mineralogy, Crystallography, and Blowpipe Analysis*, from a practical standpoint, including a description of all